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Intelligent Solar Tracking System Using Ni Labview And Daq

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Abstract: *This paper is mainly designed to control the solar panel automatically, maintains direction of the solar panel towards the sun. This is done by controlling the mechanical movement of the solar panel. Usually sun rises at east and sets at west. In ordinary system, if it faces towards east then it cannot change the direction towards sun during sunset. Because of this reason solar panel may not get sufficient sun rays to work. These problems are overcome by using this paper. So according to the sun movement intensity will be varied also the voltage and current of the solar panel changes. DC motor will be rotated such that where the array voltage is found to be maximum is, the panel is aligned in that direction.*

Solar energy is rapidly advancing as an important means of renewable energy resource. More energy is produced by tracking the solar panel to remain aligned to the sun at a right angle to the rays of light. The entire control is made with the help of Labview programming which is simple and by using DAQ (Data Acquisition System). At the same time a movable platform with sensors, instrumentation, DAQ and lab view, wireless communication is created.

Key words: solar Tracking system, Pvcell, DC motor,DAQ,LabView

INTRODUCTION:

This paper helps for power generation by setting the equipment to get maximum sunlight automatically .This paper uses voltage and current sensors. This system will detect the maximum radiation of light. When there is decrease in radiation, this system will automatically change it direction using a DC motor to get a maximum radiation from sun. This system will use a USB 6009 Data Acquisition system, Lab view programming as a brain to operate this system and a DC motor to rotate the solar panel. This system is suitable to be used in home or small factories that want to save their budget for a long term.

As we can see, there are many problems that occur in the previous type of solar tracking system. The problem that we can see here is the solar panel that we use is only in one way direction. Because of this problem, the power that can be generated is low. The second problem is the price for the solar tracking system is very expensive for the family that use more power than usual because they need to install more than one solar panel to produce enough power.

So, this paper is to fix the problem that occurs here. This solar tracking system can detect a 180 degree of rotation. So, the solar panel that can be generating here is very high compare to when the solar panel can only stay in one direction. So, the families don't have to install more than one solar panel to generate enough power. One solar panel is enough to produce a lot of power .Hence there is a need to track the sun in order to produce maximum output throughout the day in an easy way by using DAQ and LABVIEW software. The solution to the problem is our paper is"INTELLIGENT SOLAR TRACKING SYSTEM USING NI LABVIEW AND DAQ".

2.1 OBJECTIVE OF THE PAPER:

Below are the main objectives of "intelligent Solar Tracking System" projects.

1.To design a project that can detect and compare the voltage and current of the solar radiation.

2.To design a project that able to move a DC motor based on the array voltage and align the panel in the direction of maximum radiation and

3.To design a paper that would operate automatically and which is simple in implementation.

2.3 DATA ACQUISITION SYSTEM

2.3.1 Features:

8 analog inputs (14-bit, 48 kS/s)
2 analog outputs (12-bit, 150 S/s); 12 digital I/O; 32-bit counter
Bus-powered for high mobility; built-in signal connectivity
Compatible with LabVIEW, LabWindows/CVI, and Measurement Studio for Visual Studio .NET

2.3.2 Description:

The NI USB – 6009 provides connection to eight single-ended analog input (AI) channels, two analog output (AO) channels, 12 digital input/output (DIO) channels, and a 32-bit counter with a full-speed USB interface.

The National Instruments USB-6009 provides basic data acquisition functionality for applications such as simple data logging, portable measurements, and academic lab experiments. It is affordable for student use and powerful enough for more sophisticated measurement applications.

Block Diagram: PIN Diagram:

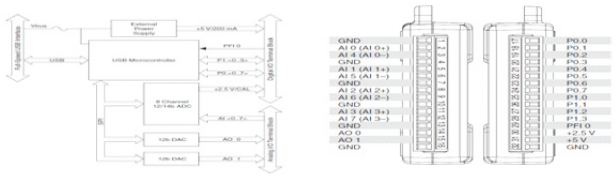


Fig 2.2(a)-Block Diagram of USB 6009 Fig 2.2(b) Pin Diagram

III. SOFTWARE REQUIREMENTS AND ITS SPECIFICATIONS

3.1 Lab VIEW

Lab VIEW is a highly productive development environment that engineers and scientists use for graphical programming and unprecedented hardware integration to rapidly design and deploy measurement and control systems. Within this flexible platform, engineers scale from design to test and from small to large systems while reusing IP and refining their processes to achieve maximum performance.

By abstracting low-level complexity and integrating the tools needed to build any measurement or control system, the graphical system design software of LabVIEW provides engineers with a platform to expedite processes and reach results faster. That includes built-in engineering-specific libraries of software functions and hardware interfaces, data analysis, visualization, and feature sharing. You can bring your vision to life with LabVIEW system design software. Through a world-class ecosystem of partners and technology alliances, a global and active user community, engineering support, and consistent annual releases, you can have the confidence to continually innovate.

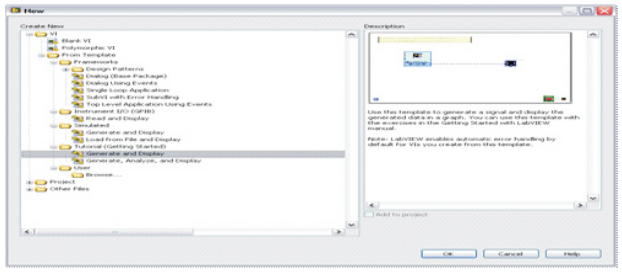


Fig-3.2(a) New VI from a template

3.4 Configuring a VI to Run Continuously until the User Stops

In the current state, the VI runs once, generates one signal, and then stops running. To run the VI until a condition occurs, you can use a While Loop.

Complete the following steps to add a While Loop to the block diagram.

1. Display the front panel and run the VI. The VI runs once and then stops. The front panel does not have a stop button.
2. Display the block diagram.
3. Click the Search button, shown at left, on the Functions palette, and enter while in the text box. LabVIEW searches as you type the first few letters and display any matches in the search results text box. If there are objects with the same name, use the information in the brackets to the right of each object name to decide which object to select. Some objects are located on multiple palettes because you can use them for multiple applications.
4. Double-click While Loop <<Execution Control>> to display the Execution Control subpalette and temporarily highlight the While Loop on the subpalette.
5. Select the While Loop on the Execution Control palette.
6. Move the cursor to the upper left corner of the block diagram. Click and drag the cursor diagonally to enclose all the Express VIs and wires, as shown in Figure.
7. Release the mouse to place the While Loop around the Express

VIs and wires.

The While Loop, shown at left, appears with a STOP button wired to the conditional terminal. This While Loop is configured to stop when the user clicks the STOP button.

8. Display the front panel and run the VI. The VI now runs until you click the STOP button. A While Loop executes the VIs and functions inside the loop until the user clicks the STOP button.
9. Click the STOP button and save the VI.

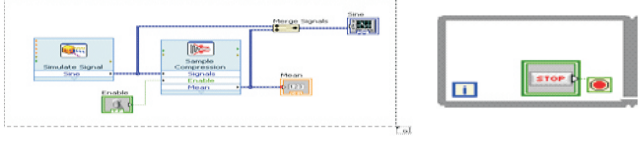


Fig-3.3(a) Simulating Sinewave

3.5 Controlling the Speed of Execution of a VI loop

To plot the points on the waveform graph more slowly, you can add a time delay to the block diagram.

Complete the following steps to control the speed at which the VI runs.

1. On the block diagram, search for the Time Delay Express VI, shown at left, on the Functions palette and place it inside the While Loop. You can use the Time Delay Express VI to control the execution rate of the VI.
2. Enter 0.25 in the Time delay (seconds) text box. This time delay specifies how fast the loop runs. With a 0.25 second time delay, the loop iterates once every quarter of a second.
3. Click the OK button to save the current configuration and close the Configure Time Delay dialog box.

4. Display the front panel and run the VI.
5. Click the Enable switch and examine the change on the graph. If the Enable switch is on, the graph displays the reduced signal. If the Enable switch is off, the graph does not display the reduced signal.
6. Click the STOP button to stop the VI.

3.6 Filtering a Signal

You can use the Filter Express VI to process signals through filters and windows. Complete the following steps to configure the Filter Express VI to filter the signal using an infinite impulse response (IIR) filter.
1. Display the block diagram window and remove the wire that connects the Result output of the Formula Express VI to the Signals input of the Amplitude and Level Measurements Express VI. Remove all broken wires that result from removing the wire.
2. Search for the Filter Express VI, shown at left, and add it to the block diagram between the Simulate Signal2 Express VI and the Amplitude and Level Measurements Express VI. The Configure Filter dialog box appears.
3. In the Filter Specifications section, change the Cutoff Frequency (Hz) to 25.
4. Click the OK button to save the configuration and close the Configure Filter dialog box.
5. Display the front panel.
6. Click the Unfiltered Signal waveform graph indicator and press the <Ctrl> key while you drag with the Positioning tool to create an additional waveform graph indicator.
7. Triple-click the Unfiltered Signal 2 label above the new waveform graph indicator and enter Filtered Signal to change the label of the indicator. You also can change the label on the Appearance page of the Graph Properties dialog box.
8. On the block diagram, wire the Result output of the Formula Express VI to the Signal input of the Filter Express VI and to the Unfiltered Signal waveform graph indicator.
9. Wire the Filtered Signal output of the Filter Express VI to the Signals input of the Amplitude and Level Measurements Express VI and to the input of the Filtered Signal waveform graph indicator.

3.7Acquiring a Signal in NI-DAQmx

You will use the DAQ Assistant Express VI to create a task in NI-DAQmx. NI-DAQmx is a programming interface you can use to communicate with data acquisition devices. Refer to the Getting Started with LabVIEW» Getting Started with DAQ»Taking an NI-DAQmx Measurement in LabVIEW book on the Contents tab in the LabVIEW Help for information about additional ways to create NI-DAQmx tasks. In the following exercises, you will create an NI-DAQmx task that continuously takes a voltage reading and plots the data on a waveform graph.

3.7.2 Editing an NI-DAQmx Task

You can add a channel to the task so you can compare two separate voltage readings. You also can customize the task to acquire the voltage readings continuously.Complete the following steps to add a new channel to the task and acquire data continuously.

1. In the block diagram window, double-click the DAQ Assistant Express VI to open the DAQ Assistant.
2. Click the Add Channels button, shown at left, and select Voltage to display the Add Channels To Task dialog box.
3. Select any unused physical channel in the Supported Physical Channels list, and click the OK button to return to the DAQ Assistant.
4. Rename the channel Second Voltage Reading. 5. In the Timing Settings section of the Configuration page, select Continuous Samples from the Acquisition Mode pull-down menu. When you set timing and triggering options in the DAQ Assistant, these options apply to all the channels in the list of channels.
6. Click the OK button to save the current configuration and close the DAQ Assistant. The Confirm Auto Loop Creation dialog box appears.
7. Click the Yes button. LabVIEW places a While Loop around the DAQ Assistant Express VI and the graph indicator on the block diagram. A stop button appears wired to the stop input of the DAQ Assistant Express VI. The stopped output of the Express VI is wired to the conditional terminal of the While Loop. The block diagram should appear similar to Figure.

Fig-3.5(b). Creating a DAQ Assitant

8. If an error occurs or you click the stop button while the VI is running, the DAQ Assistant Express VI stops reading data and the stopped output returns a TRUE value and stops the While Loop.

3.8 Other LabVIEW Features

3.8.2 All VIs and Functions

The Express VIs and structures located on the Express subpalette of the Functions palette are a small subset of the complete set of built-in VIs, functions, and structures available in LabVIEW.

Click the View button on the pinned Functions palette and select Change Visible Categories from the shortcut menu to display the Change Visible Categories dialog box. Then place checkmarks in the checkboxes next to the categories you want to view on the Functions palette. Lab VIEW uses coloured icons to distinguish between functions, VIs, and Express VIs. Icons for functions have pale yellow backgrounds, most icons for VIs have white backgrounds, and icons for Express VIs appear surrounded by pale blue fields.

VI.You can use an existing VI or a VI you create as a sub-VI. When you place a VI on the block diagram, the VI is a sub-VI. When you double-click a sub-VI, its front panel appears, rather than a dialog box in which you can configure options.

The icon for a VI appears in the upper right corner of the front panel and block diagram. This icon is the same as the icon that appears when you place the VI on the block diagram. You can use the default icon or create a custom icon

using the Icon Editor.

Refer to the Fundamentals»Creating VIs and Sub VIs book on the Contents tab in the LabVIEW Help for more information about creating VIs, configuring them as sub VIs, and creating icons.

You also can save the configuration of an Express VI as a sub VI. Refer to the Fundamentals»Building the Block Diagram book on the Contents tab in the LabVIEW Help for more information about creating sub VIs from Express Vis.

3.10 HARDWARE REQUIREMENTS

DAQ:

DAQ is data acquisition. It is device which contains both ADC & DAC in it. It is interface between analog output of sensor and the PC. The data traditional experiments in it signal from sensors are sent to analog or digital domain, read by experimenter, and recorded by hand.

Software such as LabVIEW controls the acquisition and processing of such data. Here we have to consider the following properties of the input signal

1. Sampling Rate
2. Resolution
3. Range
4. Amplification.

3.10.1 Solar cells

Solar cells work to make light into electricity directly. When light shines, electrons are liberated in the p-type region and holes produced in the n-type region; this lowers the potential energy barrier at the junction. A current flows and establishes an external potential difference.Energy in excess of the band gap is delivered as thermal energy to the solar cell, raising its temperature. It is necessary to match the band gap to the available visible light in order to minimize this heating. It is possible to use materials with band gaps of 1 to 2 eV (corresponding to the size of the visible spectrum), but a band gap of about 1.5 eV is optimum for a solar cell.

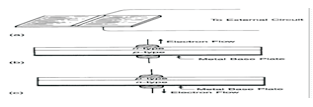


Fig-3.9(c) Solar cells.

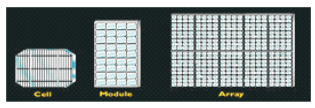


Fig-3.9(d) Cells are assembled into modules, which are further assembled into arrays.

a. Drawing of a solar cell. b. Connections for a p-type solar cell
c. Connections for a n-type solar cell. d. Actual solar cell.
(d., National Aeronautics and Space Administration)

The cells are single wafers of semiconductor. Each wafer can put out a small amount of power at the potential difference (voltage) determined by its band gap physics. To use the cells, they must be assembled into larger structures , and then into even larger structures. Figure 3.9, shows this progression.

4.2 OPERATION

Initially the solar panel is at rest position facing the East .When sun rises the voltage and current sensors start measuring voltage and current of the panel as the radiation increases. The panel is rotated to about 15 degrees in the direction of sun anti clockwise. Once again the sensors detect the voltage and current. If the array current or voltage is greater than threshold value the panel is held in that direction for about 15 minutes. Otherwise the panel is rotated to the direction of maximum radiation by continuous monitoring of voltage and current. Thus solar panel is made to tract the sun horizontally i.e., 180 degree .

At the end of the day the panel will be in direction of sunset and again it automatically aligns in the east for next day tracking.This Control is done with the help of two Switches S1 and S2. The entire process is done automatically through simple Labview coding and with the help of Data Acquisition System. The DC motor is used to change the panel direction. The two relays are used to rotate the motor in anti-clockwise, clockwise directions.

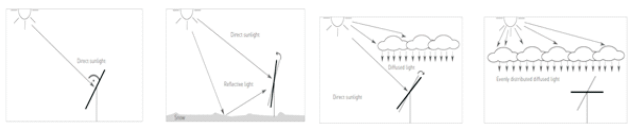


Fig-4.2(a) The tracker aligns itself to the sun. It uses both solar irradiance and reflected light.

Fig-4.2(b) The diffused light is also utilised in addition to direct sunlight and the system also detects the brightest spot.

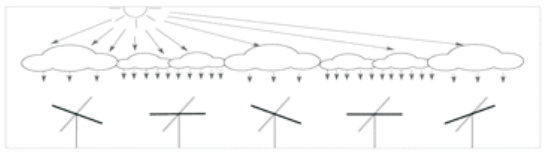


Fig-4.2(c) Through this project largest possible amount of energy is recovered.

4.3 Components used in designing the circuit

4.3.1 DC MOTOR

The parameters of the DC motor used as the movement execution element are rated voltage 24 V, rated current 3 A, maximum speed 3000 rpm. To command the motor whether to rotate in clockwise or anticlockwise two relays are used. If one relay is ON then automatically the other is in OFF condition. This DC motor is low in cost, simple in structure, and high in start torque. Also it has wide range of speed adjustment, and is easy to control. It needs hardly any maintenance .

B. Operating Characteristics:

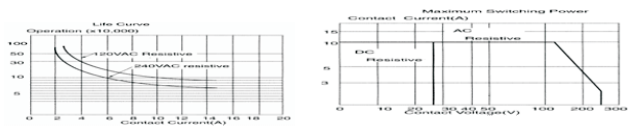


Fig-4.3(b) Operating Characteristics

B. Functional Description:

The WCS2702 consists of a precise, low-temperature drift linear hall sensor IC with temperature

compensation circuit and a current path with 98 m~ typical internal conductor resistance. This extremely low resistance can effectively reduce power loss, operating temperature and increase the reliability greatly. Applied current flowing through this conduction path generates a magnetic field which is sensed by the integrated Hall IC and converted into a proportional voltage. The terminals of the conductive path are electrically isolated from the sensor leads. This allows the WCS2702 current sensor to be used in applications requiring electrical isolation without the use of optic-isolators or other costly isolation techniques and make system more competitive in cost.

C.FUNCTIONAL BLOCK: D. PIN CONFIGURATION AND RATINGS:

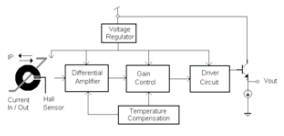
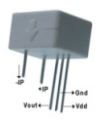


Fig-4.3(c) Functional Block Of Current Sensor



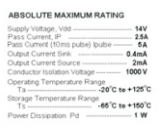

ABSOLUTE MAXIMUM RATING
Supply Voltage, Vdd 14V
Pass Current, IP 2.5A
Pass Current (10ms pulse) Ipulse 5A
Output Current Sink 0.4mA
Output Current Source 2mA
Conductor Isolation Voltage ..... 1000 V
Operating Temperature Range
TA ..... -20°C to +125°C
Storage Temperature Range
TS ..... -65°C to +150°C
Power Dissipation Pd ..... 1 W

Fig-4.3(d) Pin1 Configuration of current sensor

4.3.3 V-I CHARACTERISTICS 4.3.4 ELECTRICAL CHARACTERISTICS:

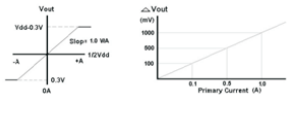


Fig-4.3.3(a) V-I Characteristics

Characteristic	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Voltage	Vcc		3.0	–	12	V
Supply Current	Isupply	IP =0 A	–	3.5	6.0	mA
Zero Current Vout	VOQ	IP =0 A	2.4	2.5	2.6	V
Primary Conductor Resistance	RPRIMARY	IP =2 A	–	98	–	mΩ
Sensitivity	△Vout	IP= ± 2.0 A	0.85	1.0	1.15	V/A
Bandwidth	BW		–	10	–	kHz
Measurable Current Range	MCR	Vdd=5V (DC current)	–	±2.0	–	A
		Vdd=5V (AC RMS)	–	1.4	–	
Temperature Drift	△Vout	Ip =0 A	–	±0.5	–	mV/°C

Table-4.3.4(b) Electrical Characteristics

V. IMPLEMENTATION AND RESULTS

5.2 Flow chart 5.3 HARDWARE IMPLEMENTATION:

Fig-5.2(a) Flow Chart Of Intelligent Solar Tracking

Fig-5.3(a) Image of the Circuit Diagram

5.4 PROGRAMMING

LabVIEW is a graphical user interface language where we can drag and drop the code instead of writing
The code design for this project is shown below.

5.4.1 Automation sub VI

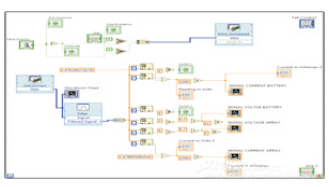


Fig-5.4(a) showing the labVIEW code

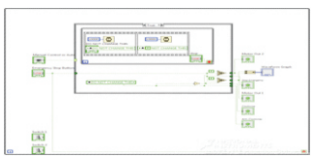


Fig-5.4.1(a) Sub VI Using Labview

Several functions used in the above code are:

Select function: Returns the value wired to the t input or f input, depending on the value of s. If s is TRUE, this function returns the value wired to t. If s is FALSE, this function returns the value wired to f. The connector pane displays the default data types for this polymorphic function.

While loop: Repeats the subdiagram inside it until the conditional terminal, an input terminal, receives a particular Boolean value. The Boolean value depends on the continuation behavior of the While Loop. Right-click the conditional terminal and select Stop if True or Continue if True from the shortcut menu. You also can wire an error cluster to the conditional terminal, right-click the terminal, and select Stop on Error or Continue while Error from the shortcut menu. The While Loop always executes at least once.

VI. SYSTEM TESTING AND RESULTS

6.1 System testing

Intelligent Solar tracking system is a system which allows tracking of the suns path horizontally based on the maximum array voltages and currents .After interfacing is done click run to run the program. The front panel of the Lab VIEW will be used to display graphs.

Then the panel is placed in the sun, the circuit ,hardware are connected to DAQ(USB 6009).If the array voltage and current are low i,e below the threshold value , DAQ will acquire the respective signals from the sensors and sends them through LabVIEW.

Fig-6.1(a) Image of project during testing.

6.2 RESULTS

The Results include successful operation of the INTELLIGENT SOLAR TRACKING SYSTEM USING NI LABVIEW AND DAQ. The DAQ acquires array voltage and current signals from sensors. Based upon the maximum values of voltage and current the panel gets aligned in that direction. Thus Solar tracking is done.

VII. CONCLUSION

This project presents a single axis solar tracking PV panel by automatic controlling. The performance of the equipment was experimentally tested in comparison with a fixed PV panel. The recorded data on day proved that the solar tracking PV panel produced more energy than the fixed one with about 57.55%. If we take into account the own energy consumption of the tracking mechanism, the mobile PV panel becomes less attractive than the fixed one, the tracking mechanism being oversized. If higher power PV panels are driven by the same tracking mechanism they may produce more energy than the fixed ones (e.g. about 38% more energy in case of a 100 W, PV panel, in the same

experimental conditions).

FUTURE SCOPE

Many Improvements can be made upon this initial design. The following recommendations are provided as ideas for future expansion of this paper:

This can be implemented with more number of panels on large scale for this to be more efficient and economical.

An Inverter can be used to convert DC to AC and by using a battery, storage can be implemented in the system.

A photodiode with an amplification circuit would provide improved resolution and better tracking accuracy/precision.

For this design different algorithm can be followed for more efficient tracking and can be given more intelligence, such as after tracking once, it will be able to predict the line of movement of the sun across the sky.

Utilizing a dual-axis design versus a single-axis to increase tracking accuracy.

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